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ORIGINAL ARTICLE

Sarcopenia in patients with malignant pleural effusion: impact on symptoms, health status, and response to hospitalization

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Abstract

Background Malignant pleural effusion (MPE) refers to the presence of neoplastic cells in the pleural fluid and was previously associated with lung cancer, breast cancer, and lymphoma. Patients with MPE effusion have significant symptoms, diminishing their overall quality of life but little is known about the influence sarcopenia may have on their clinical presentation.

Purpose To examine the prevalence of sarcopenia in patients with MPE and its relationship with symptoms, health status, and the response to hospitalization.

Methods Seventy-four patients with MPE underwent measurements of symptoms, health-related quality of life, and functional status upon admission, discharge, and 3 months after hospital discharge.

Results Patients with MPE and sarcopenia were symptomatic during hospitalization and at discharge. Additionally, health-related quality of life and functional status were worse in patients with MPE and sarcopenia. All measures of patients with MPE and sarcopenia were significantly poorer 3 months after hospital discharge.

Conclusions Sarcopenia is a clinical characteristic with substantial negative effects in patients with MPE. Specific interventions may need to be provided, designed, and offered in the clinical setting.

Keywords Malignant pleural effusion · Sarcopenia · Hospitalization · Symptoms

Introduction

Pleural effusions are the result of an abnormal accumulation of fluid in the pleural space [1] and can be caused by several mechanisms including increased permeability of the pleural membrane, increased pulmonary capillary pressure, decreased negative intrapleural pressure, decreased oncotic pressure, and obstructed lymphatic flow [2]. There are more than 60 causes of pleural effusions, with cardiac failure, pneumonia, malignant neoplasm, and pulmonary emboli, being the most common [3]. The etiology can vary according to geographical area, healthcare setting, patient age, or the time period studied, among other factors [4].

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Malignant pleural effusion (MPE) is defined as the presence of neoplastic cells in the pleural fluid [5]. The most frequent etiologies for MPE are lung cancer, breast cancer, and lymphoma, accounting for 80% of all MPE [6]. The reported incidence of MPE varies widely by patient population. Each year in the USA, an estimated 150,000 people per year develop MPE [7].

The common presenting symptom of MPE is progressive dyspnea and may be associated with chest pain or cough [8]. Signs and symptoms include weight loss, malaise, anorexia, and other [8] significant symptoms which diminish their overall quality of life [9]. The severity of symptoms often depends on the rate of fluid accumulation, rather than on the total quantity of fluid that may have accumulated over a prolonged time period [10].

Despite the progress in cancer treatment, the management of MPE remains palliative, with median survival ranging from 3 to 12 months [11]. Patient prognosis is highly variable and depends on several factors. Considering the cost of treatment for MPE and its potential complications, there are limited data that might assist chest physicians or surgeons in the precise

prediction of survival time and prognosis for patients with MPE. [12].

Sarcopenia describes age-related loss of skeletal muscle, which leads to increased risk of physical disability, poor health status, and death [13]. It is increasingly recognized as a clinical syndrome with multiple contributing factors, including physical inactivity, malnutrition, and chronic disease [14]. Sarcopenia is particularly problematic in the hospital setting, where it can adversely affect patient outcomes and could increase the length of hospital stay [15]. Hospitalization exacerbates sarcopenia, which in turn, can increase the risk of functional decline, falls, and mortality [16]. Indeed, many chronic conditions have a worsened prognosis when a patient is sarcopenic, showing an important relationship with functional status-related outcomes [14, 17]. The sarcopenia phenotype has been associated with reduced function, exercise capacity, and health status in COPD patients [14]. However, although sarcopenia has emerged as an important syndrome, with predictive ability, little research exists in patients with MPE.

The aim of this study was to examine the prevalence of sarcopenia in patients with MPE, its relationship with symptoms, health status, and response to hospitalization, which may be useful in the development of specific interventions for this particular phenotype.

Material and methods

Study design and participants

A longitudinal observational prospective cohort study was performed. Patients diagnosed with MPE, regardless of cause, who were older than 18 years of age were recruited from the Pneumology Service of the "Complejo Hospitalario Universitario" (Granada), between October 2016 and April 2018. The recruitment finished when the sample size needed for each group was attained. Informed consent was obtained from all individual participants included in the study.

Patients were excluded if they had one of these conditions: cognitive impairment, orthopedic pathologies limiting test performance, unable to participate in follow-up, neurologic pathologies limiting voluntary mobility, COPD, and asthma.

Data collection was performed at admission, at discharge, and 3 months after discharge, always by the same investigators previously trained. An interview and an initial assessment were performed to confirm that patients met inclusion criteria. Data collected from the medical history included anthropometric data, comorbidities, and pleural fluid characteristics which included severity, location (unilateral or bilateral), and etiology. Comorbidities were assessed by the Charlson index, one of the most widely used scoring systems for assessing comorbidities and has been validated in several disorders [18].

Group assignment

Patients were divided into two groups based on the presence of sarcopenia. Patients were classified with sarcopenia when they had a low muscle mass combined with low muscle strength [19]. To determine the muscle mass, the calf circumference (CC) was measured. It has been shown that a cut-off value of 31 cm may serve as an indicator for sarcopenia and that it is associated with disability and self-reported physical function [20]. CC was obtained using a standard anthropometric measuring tape with the participant in a standing position. The tape was wrapped around the calf of the non-dominant leg at the widest part to obtain the maximal circumference. Subcutaneous tissues were not compressed. Grip strength was measured to determine muscle strength during which participants squeezed a Jamar Hand Dynamometer (Sammons Preston Rolyan, USA) to their maximum ability in a seated position, in accordance with the recommendations of the American Society of Hand Therapists. The best result of three attempts for both the left and the right hand (with a 1-min pause between attempts) was recorded. The test instructors had to be convinced that the participants squeezed with maximal effort; otherwise, they did not record a test result. Low muscle strength was defined as lower than 30 kg for men and 20 kg for women [19, 20].

Outcome measures

Outcomes collected at admission, at discharge, and 3 months after discharge include symptoms and health status.

Symptomatic outcomes in this study included dyspnea, pain, cough, and fatigue.

Dyspnea was evaluated by the Multidimensional Dyspnea Profile (MDP) [21], which is a comprehensive instrument designed to measure sensory and affective dimensions of dyspnea. It comprises 12 items: an immediate sensory intensity item, an immediate unpleasantness item, five items addressing sensory qualities (e.g., tightness, muscle work), and five emotional response items (e.g., frustration, anxiety).

Pain was assessed by the visual analog scale (VAS) [22]. It consisted in a 10-cm line, labeled at the left end as 'no pain' (0) and at the right end as 'very severe pain' (10). Patients were asked to draw a vertical mark in the number which represented their current pain. The VAS is a commonly used scale that is reliable and valid to assess pain intensity. A difference of 3 points was considered as the minimal clinically important difference (MCID), according to previous studies [23].

Cough was evaluated with the Leicester Cough Questionnaire (LCQ) [24]. This questionnaire has been adequately translated and validated in Spanish [25]. It is brief, easy to administer, and well-validated chronic cough questionnaire that consists of 19 items with scores ranging from 1 to 7 and it is divided in three subscales: physical,

psychological, and social. The minimum and maximum achievable LCQ total scores are 3 and 21, respectively. A lower LCQ score signifies more cough. The MCID of the LCQ for subacute and chronic cough are 1.1, 0.4, 0.4, and 0.4 for the total, physical, psychological, and social domains, respectively [26].

The Fatigue Severity Scale (FSS) was used to assess fatigue and is a 9-item scale, scored from 1 to 7, with the greater the number suggesting more severe fatigue. The MCID has been estimated to be 20.2 in previous studies [27]. This questionnaire has been validated in a Spanish population [28].

Health status included self-perceived health status and functionality. Self-perceived health status was evaluated by the Euroqol-5dimensions (EQ-5D) and the functionality was assessed using the Functional Independence Measure (FIM).

The EQ-5D [29] was used to evaluate self-perceived health status and is divided into two sections. The first section contains five questions about mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. For each question, problems within the domain are evaluated on a three-level basis. Responders can choose between "no problems", "some problems", or "extreme problems". The second part is a VAS score, which records the responder's self-evaluated health, where 0 is the worst imaginable health and 100 is the best imaginable health. Scoring is calculated as an index value between − 0.624 and 1 (1 = perfect health) using the Danish Time Trade-off coefficient (TTO). An estimated MCID of 0.08 in the EQ-index and 7 points in the EQ-VAS subscale has been reported in previous studies [30]. The Spanish version of this tool has been validated by Badia et al. [29].

Functional status was evaluated with the FIM, which has been validated in a Spanish population [31]. The FIM is a technique used for evaluating activities of daily living (ADL). The scale consists of 18 items divided in two subscales: motor and cognitive, with a score range of 18–126 points. The results indicate the capability of performing daily life activities. Subjects were scored from "totally dependent" to "completely independent," and lower scores represented maximal disability. The reliability and validity of the FIM has been reported in various research reports [32] The MCID of the FIM scales was determined to be an improvement of 22 points on the FIM total score, 17 points on the FIM motor score, and 3 points on the FIM cognitive scale. [33].

Statistical analysis

Statistical Package SPSS version 20.0 (International Business Machines, Armonk, NY) was used to analyze the data obtained. A priori power analysis with G*Power 3.1.9.2 software was performed based on a pilot study (unpublished) of eight subjects (effect size of 0.70) obtaining a statistical power of 85% and a sample size of 78 (39 per group). We anticipated that approximately 10% of the participants might fail the initial screening or drop out; therefore, we enrolled 43 participants per group to account for this loss.

Descriptive statistics (mean ± standard deviation) were used to describe sample baseline characteristics. The Kolmogorov–Smirnov test was performed to assess continuous data normality, prior to statistical analysis. Normally distributed baseline demographic variables were compared by analysis of variance. Non-normally distributed variables were compared using the Kruskal-Wallis test. For each outcome measure, a two (sarcopenia vs. no sarcopenia) × three (hospitalization, discharge, and follow-up) two-way mixed analysis of variance was performed. If the two-by-three analysis of variance showed a significant interaction for each variable, Bonferroni's post hoc test was used to identify the specific mean differences. A 95% confidence interval was used for statistical analysis. A p value of less than 0.05 was considered as statistically significant.

Results

Our study included 74 patients with MPE divided into two groups depending on the presence of sarcopenia. The distribution of patients is shown in Fig. 1.

Baseline characteristics, symptoms, and health status of both groups of pleural effusion patients at admission are presented in Table 1.

Both groups had similar demographic characteristics at admission. The mean age was similar in both groups as well as the Charlson's index. The group with sarcopenia presented with a lower percentage of men and a higher BMI. Additionally, the pleural fluid volume was not significantly different between groups and its etiology was also similar. Pleural fluid location was similarly distributed between groups (93.75% vs 80.95%).

Significant differences were found in symptomatic outcomes. MPE patients with sarcopenia presented with a higher emotional response to dyspnea, more pain, poorer cough physical component, and more fatigue than patients without sarcopenia at admission. Regarding health status, patients in the group with sarcopenia presented with poorer results in the following EQ-5D subscales: mobility, personal care, pain, and anxiety/depression. Poorer results were also found in the functional evaluation, with a poorer functionality in the group with sarcopenia in all subscales: motor, cognitive, and total score.

Symptomatic and health status differences at discharge, between and among groups, are presented in Table 2.

In Table 2, symptomatic outcomes and health status differences among and between groups, at discharge, were found. Length of hospital stay was greater in the group with sarcopenia (14.69 vs 10.84 days). Both groups had significant differences between admission and discharge in symptomatic outcomes with a significant improvement in dyspnea

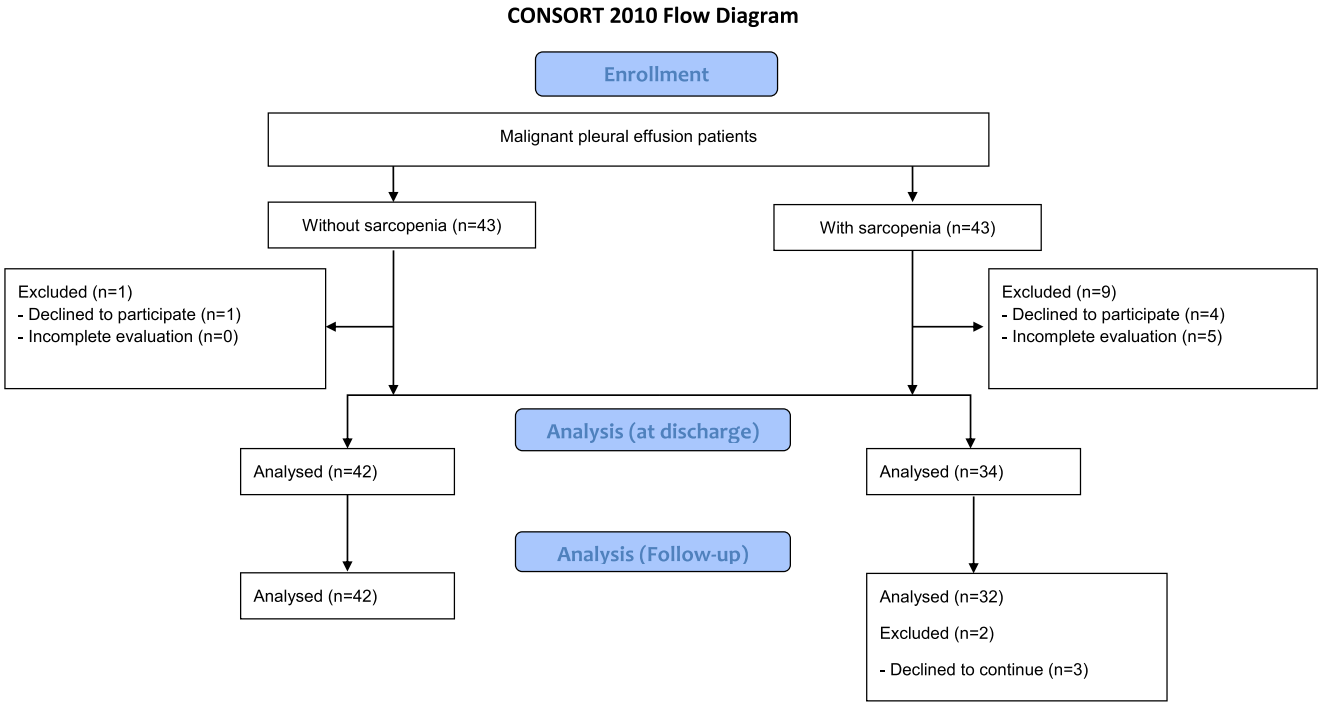

Fig. 1 Consort flow diagram of participants

(intensity, sensory qualities, and emotional response), pain, and cough subscales (physical, psychological, social, and total). Pain and cough differences were clinically significant. Fatigue scores also showed an improvement in both groups; however, they only were statistically significant in the group with sarcopenia. Significant differences were found between groups at discharge in MDP emotional response, with a poorer score in the group with sarcopenia. Regarding health status, both groups improved significantly in all EQ-5D subscales, overcoming the MCID in the EQ-5D index and EQ-5D VAS. The group with sarcopenia presented with a significantly poorer self-perceived health status compared with the non-sarcopenic group at discharge. FIM subscales improved in both groups; however, no significant clinical differences were found in these measures, and statistically significant differences were only found in the cognitive subscale in the group with sarcopenia. Significant differences were found between groups in the motor and total FIM subscales at discharge, the group without sarcopenia presented with greater functionality compared with the non-sarcopenic group.

Symptomatic outcomes and health status differences among and between groups, 3 months after discharge, are represented in Table 3.

In Table 3, symptomatic outcomes and health status differences among and between groups, 3 months after discharge, are presented. No significant differences were found in the MDP subscales; however, the group with sarcopenia presented with poorer results 3 months after discharge, with higher levels of dyspnea intensity and a poorer sensory response, than the non-sarcopenic group. The sarcopenic group also presented with a statistically significant increase in pain, although it was not clinically significant. Leicester subscores were poorer in the sarcopenic group while the group without sarcopenia had an improvement in the subscores, but only the physical subscale was statistically significant. The FSS significantly improved in the non-sarcopenic group at follow-up and was clinically significant. Significant differences were also observed between the two groups with higher levels of fatigue in the group with sarcopenia. In regard health status, significant differences were found in self-perceived health status and functionality (cognitive and total) between groups, with a poorer self-perceived health status and functionality in the sarcopenic group. The group with sarcopenia also presented with a significant increase in the EQ-5D pain subscore, reporting a higher level of pain at follow-up. Both groups were observed to have decreased FIM scores, presenting with a poorer functionality at follow-up; however, these differences were not significant.

Discussion

The aim of this study was to examine the presence of sarcopenia in patients with MPE and its relationship with symptoms, health status, and response to hospitalization, which may be useful in the development of specific interventions for this particular phenotype.

Our findings show that sarcopenia influences MPE and increases the length of hospital stay. Moreover, patients with sarcopenia presented with poorer symptomatology and health

Table 1 Baseline characteristics of pleural effusion patients

		MPE with sarcopenia ($n = 43$)	MPE without sarcopenia ($n = 43$)	P
Sex (% men)		50	76.2	0.019
Age (years)		71.75 ± 13.17	66.19 ± 13.7	0.081
BMI (kg/m^2)		27.81 ± 4.73	22.37 ± 3.11	< 0.001
Charlson index		4.06 ± 2.23	3.13 ± 2.03	0.069
Pleural fluid volume		2.53 ± 0.82	2.44 ± 0.78	0.623
Location (% unilateral)		93.75	80.95	0.266
Pleural effusion etiology				
Lung cancer		40.5	56.3	0.222
Breast cancer		14.3	12.5	
Lymphoma		2.4	6.3	
Symptomatic outcomes				
MDP	Intensity	6.44 ± 2.64	5.27 ± 3.26	0.103
	Sensory qualities	24.63 ± 16.36	20.49 ± 13.53	0.241
	Emotional response	23.44 ± 10.41	17.83 ± 12.16	0.041
VAS		6.13 ± 3.25	4.45 ± 3.73	0.047
Leicester	Physical	4.12 ± 1.93	4.96 ± 1.67	0.049
	Psychological	4.81 ± 1.8	5.44 ± 1.55	0.111
	Social	4.56 ± 2.15	5.30 ± 1.80	0.110
	Total	13.5 ± 4.99	15.63 ± 4.69	0.062
FSS		49.63 ± 10.23	40.38 ± 16.37	0.007
Health status				
EQ-5D	Mobility	2.19 ± 0.738	1.57 ± 0.547	< 0.001
	Personal care	1.94 ± 0.759	1.60 ± 0.665	0.043
	Daily activity	2.44 ± 0.716	2.21 ± 0.813	0.222
	Pain	2.38 ± 0.707	2 ± 0.765	0.034
	Anxiety/depression	2 ± 0.830	1.60 ± 0.627	0.021
	VAS	39.38 ± 18.741	45.86 ± 19.447	0.153
FIM	Motor	76.69 ± 15.698	84.35 ± 8.939	0.009
	Cognitive	32.63 ± 2.612	34.26 ± 1.941	0.003
	Total	109.31 ± 17.331	118.42 ± 9.669	0.005

MPE malignant pleural effusion, *BMI* body mass index, *MDP* multidimensional dyspnea profile, *VAS* visual analog scale, *FSS* Fatigue Severity Scale, *EQ-5D* Euroqol-5dimensions, *FIM* functional independence measure

Data expressed as mean ± standard deviation or percentage (%)

status at admission and had a poorer recovery. Sarcopenia as an important determinant for prognosis in other diseases [14, 17] and a better understanding of its relationship with the MPE is important in the development of future physical activity/exercise training or nutritional interventions in this phenotype of patients.

The sample of subjects included in this study was representative of the general population of patients with MPE, with similar age range and pleural effusion etiology. Moreover, the final sample of participants was similar to that of previous studies with this pathology [34]. Both groups presented with similar sociodemographic characteristics, pleural effusion etiology, and pleural fluid volume. The BMI was higher in the non-sarcopenic group, similar to other studies about sarcopenia in patients with respiratory problems [14].

To the best of our knowledge, this is the first attempt to study sarcopenia inpatients with MPE. Sarcopenia has been studied previously in populations with lung cancer [35] and COPD [14], and like our results have shown important relationships with prognosis and function.

Our results also show an important impact on hospitalization, with a longer length of hospital stay in the group of patients with sarcopenia. Gariballa et al. [36] presented similar results analyzing a sample of 432 older hospitalized patients showing a length of hospital stay significantly longer in patients diagnosed with sarcopenia compared with patients without it. However, they did not study the effects of sarcopenia on clinical outcomes. In the last several years, different studies [37, 38] have focused on a wide variety of patient populations showing that poor physical status is related to poorer

Table 2 Symptomatic outcomes and health status changes, among and between groups, at discharge

		MPE with sarcopenia ($n = 34$)			MPE without sarcopenia ($n = 42$)			P (between groups)
		Mean difference	CI (95%)	p (among groups)	Mean difference	CI (95%)	p (among groups)	
Length of hospital stay		14.69 ± 8.97			10.84 ± 5.7			0.026
Symptomatic outcomes								
MDP	Intensity	3.214	[2.116–4.313]	< 0.001	2.457	(1.345–3.57)	< 0.001	0.835
	Sensory qualities	17.214	[11.891–22.538]	< 0.001	11.657	(7.355–15.959)	< 0.001	0.963
	Emotional response	9.286	[5.839–12.733]	< 0.001	8.343	(4.634–12.052)	< 0.001	0.038
VAS		3.929	[2.353–5.504]	< 0.001	3.028	(1.874–4.182)	< 0.001	0.148
Leicester	Physical	− 1.5	[− 2.441–− 0.559]	0.003	− 0.958	(− 1.406–− 0.510)	< 0.001	0.106
	Psychological	− 1.428	[− 2124–− 0.733]	< 0.001	− 0.833	(0.197–− 1.234)	< 0.001	0.629
	Social	− 2	[− 2.804–− 1.196]	< 0.001	− 0.965	(1.516–0.252)	0.001	0.722
	Total	− 5.071	[− 7.093–− 3.05]	< 0.001	− 3.007	(3.705–0.635)	< 0.001	0.349
FSS		10.50	[4.8–16.191]	0.001	4.343	(− 0,705–9.391)	0.089	0.190
Health status								
EQ-5D	Mobility	0.571	[0.284–0.859]	< 0.001	0.250	[0.081–− 0.419]	0.005	0.070
	Personal care	0.429	[0.105–0.753]	0.011	0.361	[0.145–0.577]	0.002	0.163
	Daily activity	0.571	[0.247–0.895]	0.001	0.583	[0.379–0.788]	< 0.001	0.489
	Pain	0.929	[0.549–1.308]	< 0.001	0.667	[0.424–0.909]	< 0.001	0.767
	Anxiety/depression	0.385	[0.184–0.585]	0.001	0.250	[0.620–0.438]	0.010	0.477
	Index	− 0.554	[− 0.735–− 0.374]	< 0.001	− 0.348	[− 0.485–− 0.211]	< 0.001	0.610
	VAS	− 13.286	[− 20.972–− 5.599]	0.001	− 23.25	[− 30.686–− 15.814]	< 0.001	0.002
FIM	Motor	− 0.571	[− 9.556–8.413]	0.897	− 1.778	[− 3.895–0.339]	0.097	0.032
	Cognitive	− 1.429	[− 2.404–− 0.453]	0.006	− 0.194	[− 0.692–0.303]	0.433	0.296
	Total	− 1.357	[− 10.477–7.762]	0.762	− 2.056	[− 4.3–0.189]	0.071	0.015

MPE malignant pleural effusion, *CI* confidence interval, *MDP* multidimensional dyspnea profile, *VAS* visual analog scale, *FSS* Fatigue Severity Scale, *EQ-5D* Euroqol-5dimensions, *FIM* functional independence measurement

prognosis. Our results go further showing significantly greater symptoms across data collection points in patients with sarcopenia when compared to patients without sarcopenia.

In our study, MPE patients with sarcopenia presented with poorer symptomatology and health status at admission. Prado et al. [39] found similar results in a study with lung and colorectal cancer patients. They analyzed a sample of 28 patients showing that sarcopenia was associated with poor clinical outcomes, including physical function. Kilgour et al. [40] found that sarcopenia was related to fatigue in a sample of 84 advanced cancer patients, highlighting an important relationship that we observed in our study.

Our results also found a poorer self-perceived health status and functionality in sarcopenic MPE patients at discharge and 3 months after discharge. Jones et al. [14] found similar results in 622 patients with COPD and showed that patients with sarcopenia were weaker, had a lower BMI, reduced exercise capacity and functional performance than non-sarcopenic patients. Similarly, but examining quality of life variables, Won Go et al. [41] studied sarcopenia in healthy Korean men and found poorer EQ-5D values in the sarcopenic group, demonstrating greater problems with mobility and usual activity. Our study has shown important differences between groups in perceived health status and functionality from hospitalization to follow-up, with poorer values in the sarcopenic group.

Limitations of this study have to be taken into account including that groups were not analyzed by MPE etiology. Another important limitation is the inherent difficulty in measuring anthropometric indices to calculate muscle mass instead of a bioelectrical impedance analysis, which could be more accurate. However, we have found many studies in which this method is used and validated [42]. Third, could be the lack of the data about the history of cancer, which could affect the results, although previous studies about MPE did not include these data [43].

Future longitudinal studies are required to examine the effects of specific interventions in subjects with this phenotype. Physical activity training, nutritional, or pharmacological

Table 3 Symptomatic outcomes and health status of patients at follow-up

After 3 months		MPE with sarcopenia ($n = 32$)			MPE without sarcopenia ($n = 42$)			P (between groups)
		Mean difference	CI (95%)	p (among groups)	Mean difference	CI (95%)	p (among groups)	
Symptomatic outcomes								
MDP	Intensity	− 1	[− 3.483–1.483]	0.348	0.643	[− 1.684–2.97]	0.561	0.369
	Sensory qualities	− 6	[− 12.769–0.769]	0.072	5.429	[− 1.656–12.513]	0.122	0.166
	Emotional response	5	[− 8.141–18.141]	0.373	3.429	[− 1.211–8.068]	0.134	0.229
VAS		− 2	[− 3.877–− 0.123]	0.041	0.214	[0.903–− 1.736]	0.816	0.084
Leicester	Physical	0.333	[− 0.208–0.875]	0.175	− 0.643	[− 1.073–− 0.213]	0.007	0.161
	Psychological	0.667	[− 0.417–1.75]	0.175	− 0.357	[− 0.84–0.129]	0.136	0.281
	Social	1	[0.632–− 0.625]	0.175	0	[− 0.555–0.555]	1	0.404
	Total	2.333	[− 1.46–6.127]	0.175	− 0.846	[− 1.999–0.307]	0.136	0.261
FSS		3	[− 23.829–29.829]	0.785	14.571	[4.727–24.416]	0.007	0.004
Health status								
EQ-5D	Mobility	0.333	[− 0.209–0.875]	0.175	− 0.143	[− 0.353–0.067]	0.165	0.865
	Personal care	0	[− 0.939–0.939]	1	− 0.143	[− 0.451–0.166]	0.336	0.193
	Daily activity	0	[− 0.939–0.939]	1	0	[− 0.453–0.453]	1	0.175
	Pain	− 0.667	[− 1.209–0.125]	0.025	− 0.214	[− 0.777–0.349]	0.426	0.223
	Anxiety/depression	0	[− 0.939–0.939]	1	− 0.214	[− 0.618–0.189]	0.272	0.508
	Index	0.597	[− 0.425–0.544]	0.764	0.104	[− 0.076–0.284]	0.234	0.687
	VAS	10	[− 18.548–38.548]	0.409	2.286	[− 12.216–16.788]	0.738	0.004
FIM	Motor	5.667	[− 5.212–16.546]	0.238	2.429	[− 2.506–7.363]	0.307	0.077
	Cognitive	3	[− 1.301–7.301]	0.133	0.357	[− 0.307–1.022]	0.266	0.013
	Total	9	[− 5.632–23.632]	0.175	2.786	[− 2.483–8.054]	0.274	0.050

MPE malignant pleural effusion, *CI* confidence interval, *MDP* multidimensional dyspnea profile, *VAS* visual analog scale, *FSS* Fatigue Severity Scale, *EQ-5D* Euroqol-5dimensions, *FIM* functional independence measurement

interventions have been used to manage sarcopenia in other populations [44, 45]. The results of our study provide important data to better understand the effects of sarcopenia in MPE and lays a foundation to examine the effects of the above interventions on patients with combined sarcopenia and MPE.

Conclusions

Sarcopenia is an important factor to take into account in patients with MPE. Patients with MPE present with poorer symptomatology, self-perceived health status, and functionality than the non-sarcopenic patients at admission. The presence of sarcopenia appears to increase the length of hospital stay and is associated with a poorer response to hospitalization, which appears to cover over into the recovery and possibly survival of such patients.

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Compliance with ethical standards All patients' data are confidential.

Conflict of interest The authors declare that they have no conflict of interest.

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